



# Structural and Functional Discovery in Dynamic Networks with Non-negative Matrix Factorization

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Time series of graphs are increasingly prevalent in modern data and pose unique challenges to visual exploration and pattern extraction. This paper describes the development and application of matrix factorizations for exploration and time-varying community detection in time-evolving graph sequences. The matrix factorization model allows the user to home in on and display interesting, underlying structure and its evolution over time. The methods are scalable to weighted networks with a large number of time points or nodes, and can accommodate sudden changes to graph topology. Our techniques are demonstrated with several dynamic graph series from both synthetic and real world data, including citation and trade networks. These examples illustrate how users can steer the techniques and combine them with existing methods to discover and display meaningful patterns in sizable graphs over many time points.

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